PB-215 954

# WATER SUPPLY MANAGEMENT IN THE PACKAGED DISASTER HOSPITAL

Public Health Service
Washington, D. C.

1965

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*Health Mobilization Series* F-6

# Water Supply Management in the Packaged Disaster Hospital

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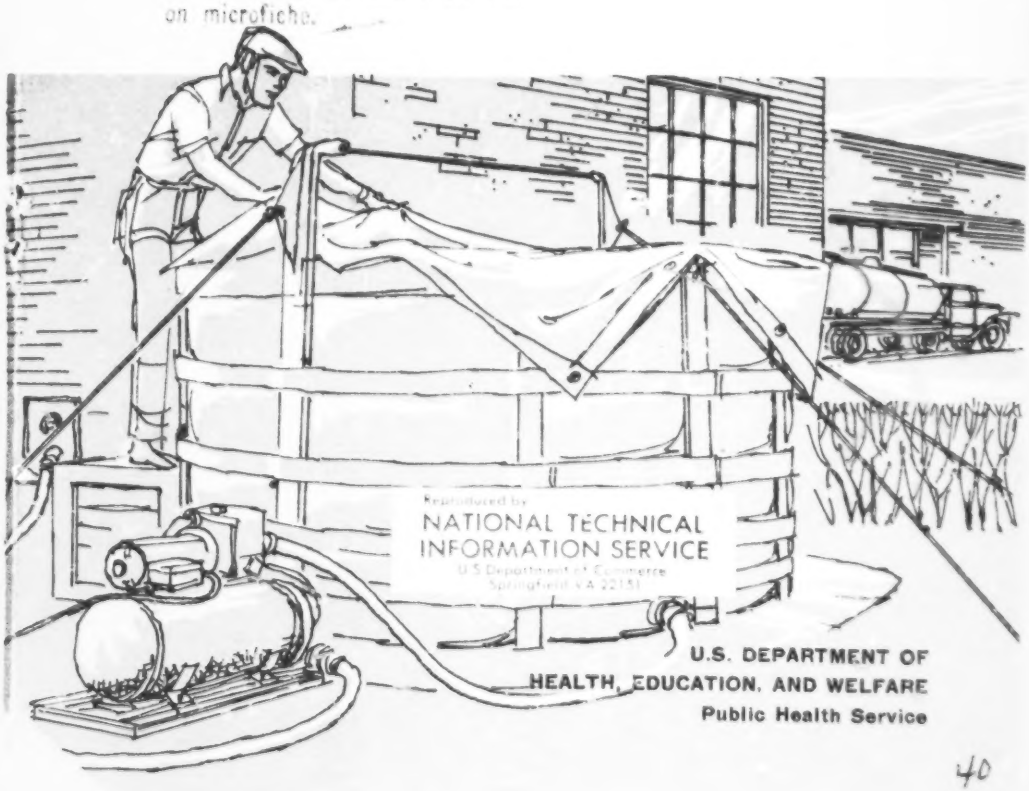

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U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Public Health Service

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*Health Mobilization Series* F-6

# Water Supply Management in the Packaged Disaster Hospital

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Public Health Service
Division of Health Mobilization
1965

Public Health Service Publication No. 1071-F-6

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# INTRODUCTION

In the event of a thermonuclear attack on the United States, it is assumed that a major proportion of existing hospital facilities would be destroyed. Simultaneously, there would be an unprecedented need for hospital beds and services. In recognition of these facts, the Federal Government and, more recently and specifically, the U.S. Public Health Service has, with the assistance and cooperation of the 50 States and two territories, pre-positioned Packaged Disaster Hospitals (PDH's) in more than 2,000 communities throughout the nation.

The PDH is a unit of supplies and equipment which, in disaster, can be set up in an existing building, such as a school, to supply an austere but functional general hospital. It contains sufficient facilities for a professional staff to provide essential medical and surgical care for as many as 200 bed-patients.

A PDH can also be used to augment the supplies and equipment of an existing hospital, thus permitting it to expand operations to accommodate mass casualties of a man-made or natural disaster, such as a nuclear attack, a large-scale industrial accident, flood, or hurricane.

The normal functions of a well-equipped and fully staffed hospital are dependent in large measure on a bacteriologically safe and adequate quantity of water. Under conditions envisioned to exist when the use of the PDH is warranted, efficient use of available potable water will be mandatory if the mission of the emergency facility is to be fulfilled.

This booklet is the sixth in a series developed to assist those persons in a community responsible for preparing to use the PDH in a disaster. The content of this publication is directed specifically to those individuals who will actually operate the water supply section of the PDH. It discusses water conservation techniques, suggests guidelines for meeting the emergency water requirements of the PDH (both quantity and quality), and contains sufficient information to be used as a training manual for familiarizing assigned operating personnel with their responsibilities and with actions required to activate the water supply section.

Those individuals responsible for selection of emergency water supplies, or who are involved with transmission or haulage of water during or immediately following a disaster, should also find this handbook useful for ready reference.

# WATER SUPPLY CONSIDERATIONS

## A. MINIMUM PDH WATER REQUIREMENTS

The rate of potable water usage required to support all continuing emergency medical services, for which the 200-bed Packaged Disaster Hospital was designed, is estimated to be 2,000 gallons per day (10 gallons per person per day).*

Under an austere environment, holding the consumption to this rate will require strict enforcement of appropriate water conservation measures and advance planning. Operating all services of the hospital in an unrestricted manner could result in a water demand of as much as 30,000 gallons per day. Under optimum conditions, the water supply equipment included with the PDH can supply about 15,000 gallons per day if the water, supportive fuels, supplies, and manpower are available.

## B. WATER CONSERVATION MEASURES

The immediate objective of PDH water managers in a disaster is to make efficient use of all water available for the Packaged Disaster Hospital, thereby reducing auxiliary equipment and manpower requirements. PDH's functioning as a separate entity will encounter water supply problems peculiar to the building selected to house the facility. Invoking certain general water conservation measures will assist markedly in meeting the above objective.

These precautions include:

1. Closing off any damaged or leaking water outlets.

2. Regulating flushing of water closets and urinals, or shutting off these units and using nonpotable water carried to the area as needed for manual flushing.

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*If food preparation facilities, patient decontamination centers, or laundry areas are operated, additional water may be required.

3. Prohibiting baths or showers by ambulatory patients and assuring compliance by closing water-line control valves.

4. Washing and rinsing surgical instruments in basins rather than under faucets.

5. Rationing water to functional sections of the hospital, such as triage, sterile supply, wards, and operating room.

6. Instructing kitchen and housekeeping personnel in methods of accomplishing respective responsibilities with a minimum of water.

7. Placing appropriate signs in strategic areas as reminders to use water only if absolutely necessary.

When PDH's are functioning as adjunct units of a regular hospital, more extensive restrictions on water use will be advisable. These include:

1. Substituting paper products for linens and dishes where possible.

2. Using minimum washing formula to remove soil from linen and using rinse water as wash water for subsequent linen washing.

3. Collecting water condensation from refrigeration equipment or steam systems and reusing for clothes washing and heating purposes.

4. Discontinuing use of bedpan washers.

5. Using *pressure* sterilizers, whenever possible, in lieu of boiling.

6. Constructing latrines in appropriate locations for ambulant patients and staff.

Additional curtailment of indiscreet use of water will probably be possible in any particular situation. The severity of damage to the normal water supply source and distribution system will, of course, determine the degree of water conservation necessary at the time.

## C. SOURCES OF WATER SUPPLY

Water of questionable quality must not be considered for use in the Packaged Disaster Hospital, unless it is used for manual flushing of sanitary fixtures only and not introduced into the emergency distribution system. Predisaster planning for provision of a minimum of 2,000 gallons of water per day from remote sources may be the key preparation in the successful operation of the hospital.

The emergency water equipment in the PDH provides only facilities for holding and chlorinating water. Therefore, if the effects of a disaster are so severe that potable water is not available within a reasonable mutual-assistance distance from local PDH sites, the PDH should be moved to a site which has access to a suitable water source.

The above considerations are discussed in Necessary Predisaster Preparations, page 5.

Possible water supplies for use in the PDH will be limited by the severity of any particular disaster. Each source clearly suitable for use predisaster should be reviewed in the light of the prevailing circumstances following the initial disaster impact to be sure they are still usable and accessible. If several water sources of suitable quality are available after this analysis, the one which requires the least equipment and manpower to transport or treat the water from it should be used.

Depending on the situation, water from the following alternate sources may be available for use in the PDH:

1. The isolated, undamaged portion of the community water distribution system, provided treatment facilities are operating.

2. Community or individual wells within the city or in outlying areas if their sanitary protection remains intact. This determinaton should be made by a qualified health official, sanitary engineer, or sanitarian following the disaster.

3. Water from private treatment facilities of local industry, e.g. soft drink manufacturers. In addition to water supply, such plants generally have mixed-resin ion exchange filters capable of producing chemically safe water even from fallout contaminated water.

4. Watering points on nearby or distant municipal or private water systems.

5. Interconnections, either permanent or temporary, with adjacent municipal or private water transmission or distribution systems.

6. Treated water from storage reservoirs, standpipes, or elevated tanks.

In the event water sources are suspected of containing nuclear contaminants, frequent checks should be made with the local waterworks superintendent or civil defense radiological monitoring teams to assure safe water for the PDH. Stored water and sub-surface water supplies will generally be free of such contamination.

# NECESSARY PREDISASTER PREPARATIONS

## A. ARRANGEMENTS TO ASSURE ADEQUATE WATER SUPPLY

The lack of suitable water could prevent the operation of a PDH. Essential predisaster preparations to insure availability of adequate water include:

1. Assigning responsibility for investigating all possible sources of potable water (local and distant) for use in the PDH. (See Section C, p. 3). Personnel assigned should include a sanitary engineer or a sanitarian.

2. Assigning responsibility for surveying all ways and means of delivering water to the PDH. This includes:

   a. Identifying and designating tank trucks, tank cars or other mobile containers that could be used for this purpose along with appropriate cleaning equipment.

   b. Establishing alternate or supplemental sources of other water supply equipment such as aluminum irrigation pipe, plastic pipe, pumps, hose, etc. These may be available for loan from local water, fire and rescue departments; from local proprietors' stocks (especially rental equipment establishments), and from farms or farm equipment supply houses.

## B. PREPARATIONS FOR USE OF PDH WATER SUPPLY EQUIPMENT

During a major disaster, the normal supply of water to the building selected for a PDH is likely to be disrupted and may not be restored for some time. For this reason, each PDH contains a water storage tank and a pumping unit with pressure tank which have sufficient capacities to meet minimal demands of the disaster hospital. If this emergency equipment is to be installed promptly without confusion, certain predisaster preparations are essential.

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These preparations include:

1. Assigning responsibility for setting up and operating the water supply equipment in disaster. These duties could be handled by persons with moderate mechanical experience, such as hospital or school custodial personnel, plumbers, firemen, water, or sewer plant operators and maintenance personnel, service station employees, etc.

2. Familiarizing assignees with the equipment and techniques of asasembly. Local climatic conditions and physical characteristics of possible PDH sites may require modifications to the assembly procedures outlined in this booklet. (The standard hookup assumes that water is delivered to the tank by auxiliary equipment and that water requirements are confined to the ground floor.) Training sessions should be supervised by a sanitary engineer, sanitarian, waterworks operator, swimming pool operator, or other technically qualified person.

3. Instructing assigned PDH staff in water disinfection procedures and conservation measures. Extreme care is required in all phases of procurement, transmission, treatment and delivery of water for a PDH. Thorough sanitary precautions are necessary in order to insure that disease is not transmitted through the water supply. All planning and practice training sessions should be supervised by sanitary engineers or other appropriately trained health personnel.

4. Developing plans in cooperation with technical persons for any necessary alternate uses of equipment, considering the type of available water sources and climate in the region. Such uses will require supplies in addition to those in the PDH and procurement would be an integral part of predisaster planning.

5. Discussing the water supply management plans for the PDH with the local civil defense agency and local water supply officials and determining their ability to assist in providing water, or purification and/or transportation equipment in case private sources are insufficient or unavailable.

6. Developing a plan for laying out emergency plastic water lines in the buildings selected for possible operation of the PDH.

7. Instituting formal arrangements with owners of water sources and equipment suitable for use in conjunction with supplying water to the

PDH site. Agreements for furnishing miscellaneous supplies listed in Table 1 (p. 11), or their equivalent, should be included if a PDH not containing these items must be activated. If these supplies are added to the PDH through supply additions, then such arrangements can be annulled.

8. Developing written procedures for invoking conservation measures outlined in Section B, page 2.

# WATER SUPPLY EQUIPMENT AND ACCESSORIES

The PDH water supply equipment and accessories are packed in seven separate cases (five cases in PDH's prior to Series 62000, if Supply Addition No. 2 is included, otherwise only two cases).

Refer to Table 1, and Table 2, (p. 11) for PDH case numbers containing water-supply equipment and accessories.

## A. TANK

The tank has 1,500-gallon capacity, is rubber-coated nylon, and comes with ground cloth, tank cover, staves, stave cap extentions, support tubes, stakes,[1] guy and tie ropes, and fabric repair kit.

## B. PUMPING UNIT

The unit is electrically operated, rated at 10 gallons per minute against 100 feet total head.[2] The accessory items packaged with pumping unit include:

**1. Suction Hose Assembly:**

2—20′ lengths, 1¼″ diameter rubberized hose plus:

***a. In Series 62000 PDH***

1 Hose Bushing, brass, 2″ Male Hose Thd.* x 1¼″ Female Hose Thd.

1 Hose Nipple, brass, 1¼″ Male Hose Thd. x 1¼″ Male Pipe Thd.

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[1] Not included with tanks generally supplied with Series 53000-55000 PDH's.

[2] In Series 62000 PDH, jet pump mounted atop 15-gallon pneumatic tank; earlier models, 6-gallon pneumatic tank mounted atop centrifugal pump.

*Note: All hose threads are NPSH. All pipe threads and galvanized fitting threads are NPT.

*b. In series 53000–57000 PDH* [3]

1 Nipple, galv., 2″ close
1 Reducer, galv., 2″ x 1¼″
1 Nipple, galv., 1¼″, close

**2. Discharge Hose Assembly:**

2—20′ lengths, 1″ diameter rubberized hose plus:

*a. In Series 62000 PDH*

1 Hose Bushing, br.., ¾″ Female Hose Thd. x 1″ Male Hose Thd.
1 Hose Nipple, brass, 1″ Female Hose Thd. x 1″ Male Pipe Thd.
1 Hose Nipple, brass, 1″ Female Pipe Thd. x 1″ Male Hose Thd.

*b. In Series 53000–57000 PDH* [4]

1 Hose Bushing, brass, 1″ Male Pipe Thd. x ¾″ Female Hose Thd.
1 Extension Piece, galv., 1″ Male Pipe Thd. x 1″ Female Pipe Thd., 2″ long
(Generally not required in making connections to building piping.)

**3. Toolbox** [5]

In addition to pipe fittings it contains:

2 Operation and Maintenance Manuals or Instruction Sheets

1 Pair 6″ Slip Joint Pliers with Wire Cutter (not diagonal-type cutter)
(No wire cutters on pliers with pumping unit of Series 62000 PDH; diagonal wire cutters included with Tool Section of Series 62000 PDH (Case 690).)

1 Screwdriver, 3″ Blade, wood handle (Not in toolbox with pumping unit in Series 62000 PDH but 3″ and 4″ plastic handled screwdrivers provided in Tool Section of PDH (Case 690).)

[3] Located in toolbox mounted on pump base.
[4] Located in toolbox mounted on pump base.
[5] Cardboard box with pumping unit of Series 62000 PDH; metal box mounted on pump base in earlier series.

2 Open End Wrenches ($\frac{3}{8}$" x $\frac{7}{16}$" and $\frac{1}{2}$" x $\frac{9}{16}$")

2 Allen Wrenches, $\frac{5}{32}$" (for $\frac{5}{16}$" Setscrews) and $\frac{1}{8}$" (for $\frac{1}{4}$" Setscrews)

(Not required for or provided with pumping unit in Series 62000 PDH.)

1 Hose Spanner Wrench, for 1" and $1\frac{1}{4}$" pin lugs (Spanner Wrench provided with pumping unit of Series 62000 PDH for $1\frac{1}{4}$" pin lugs only.)

1 Adjustable Monkey Wrench, 11" (Not required for or provided with pumping unit in PDH's prior to Series 62000.)

1 Aluminum Funnel, $2\frac{1}{2}$" diameter ($3\frac{7}{8}$" diameter funnel included with pumping unit of Series 62000 PDH.)

1 Package Graphite Impregnated Packing, $\frac{1}{4}$" square x $2\frac{7}{8}$", 10 pieces (Not required for or provided with pumping unit in Series 6200 PDH.

1 Stick Pipe Thread Compound

4 Rubber Hose Washers, $1\frac{1}{4}$"

4 Rubber Hose Washers, 1"

1 Rubber Hose Water, $\frac{3}{4}$" (Not in tool box of pumping unit in Series 62000 PDH but is provided in Miscellaneous Fittings and Supplies (Case 629).)

2 Plug Fuses, time delay, 15 amp.

## C. MISCELLANEOUS FITTINGS AND SUPPLIES

(See Table 1 for detailed description of items.)

The supplies enumerated in Table 1 are provided in the Series 62000 PDH and Supply Addition No. 2 to permit flexibility in the method of delivering water to the functional sections of the PDH. Some disasters may disrupt the water piping of the PDH building as well as water mains, necessitating the use of temporary lines. The garden hose, nozzles, Y-connectors, and Lyster bags may be used in this eventuality. The adapter will permit direct connection of the garden hose to the pumping unit in lieu of the 1-inch discharge hose connection.

## Table 1. Miscellaneous Supplies

| Quantity and Description | Series 62000 PDH Case Numbers | Supply Addition #2 Case Numbers |
|---|---|---|
| 1 Adapter, brass, 1" male pipe thread x ¾" male hose thread (adapts 1" female pipe thread of pump discharge to accept female hose thread of garden hose) | 629 | 535 |
| 12 Garden Hose Clamps, ⅝" | 629 | 535 |
| 6 Garden Hose Coupling Assemblies, female and male section, for ⅝" hose | 629 | 535 |
| 4 Garden Hose Nozzles | 629 | 535 |
| 4 Clips, nonmetallic washers, ¾" 10s | 629 | 535 |
| 4 Y-Shaped Connectors, ¾", ~~with 1 female~~ *and 2 male* threads | 629 | (*) |
| 1 Chlorine Color Comparator | 629 | 539 |
| 24 Cans, 70 percent Calcium Hypochlorite, 3¾ lbs. each | 630, 631 | (*) |
| 4 50' Lengths Rubber Garden Hose, ⅝" | 632 | 540 |
| 3 Water Bags, cotton duck, 36 gal. (Lyster Bags) | 635 | (*) |

* These Water Supply Accessories to be added to earlier Series in a subsequent supply addition.

## Table 2. PDH Cases Containing Water Supply Equipment, Accessories, and Supplies

| Quantity and Description | Case Numbers | | | | | | |
|---|---|---|---|---|---|---|---|
| | PDH Series | | | | | | Supply Addition #2 |
| | 62000 | 57000 | 56000 | 55000 | 54000 | 53000 | |
| 1 Miscellaneous Supplies (See Table 1, above, for detailed contents) | 629 | ..... | ..... | ..... | ..... | ..... | 535 |
| 1 Chlorine Color Comparator | 629 | ..... | ..... | ..... | ..... | ..... | *539 |
| 24 Cans, 70 percent Calcium Hypochlorite, 3¾ lbs. each | 630 | ..... | ..... | ..... | ..... | ..... | ..... |
| | 631 | | | | | | |
| 4 Hose, garden rubber, ⅝" I.D., 50' lengths | 632 | ..... | ..... | ..... | ..... | ..... | 540 |
| 1 Water Storage Tank, 1,500 gal. | 633 | 362 | 353 | 323 | 110 | 340 | ..... |
| 1 Water Pumping Unit, 10 gal. per min. at 100' head | 634 | 363 | 352 | 321 | 109 | 341 | ..... |
| 3 Bag, cotton duck, 36 gal. (Lyster Bag) | 635 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 Mixed Case, Broom and Brush | 651 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 Mixed Case, Nails, Mopheads | 652 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 Mixed Case, Hand Tools | 690 | ..... | ..... | ..... | ..... | ..... | ..... |

*Case also contains miscellaneous dental and surgical equipment.

# ASSEMBLY INSTRUCTIONS AND INFORMATION

## A. WATER STORAGE TANK

### 1. General

Three different manufacturers have fabricated water storage tanks for use in the PDH's:

| *Manufacturer* | *PDH Series** |
|---|---|
| U.S. Rubber Co., Providence, R.I. | 53000, 54000, 55000 |
| St. Clair Rubber Co., Detroit, Mich. | 56000, 57000 |
| The Firestone Tire & Rubber Co, Akron, Ohio | 62000 |

Since each type of tank varies in style of components, minor differences in assembly technique will be necessary. These differences are noted throughout the instructions and assembly procedures discussed herein.

### 2. Manpower and Set-up Time

Four men can uncrate and assemble the water tank in 30 minutes using the proper tools.

### 3. Weight

The crated tank weighs about 450 pounds. It can be handled easiest with a dolly or forklift.

### 4. Tools Required for Uncrating

A small wrecking bar and claw hammer are the only tools absolutely necessary to open crate. Tin snips, if available, can be used for band-breaking instead of the technique illustrated on the opposite page.

Crate corners can be partially loosened with a large screwdriver so the wrecking bar will not damage crate.

**Note:** ***Tools are provided for uncrating in Series 62000 PDH only.***

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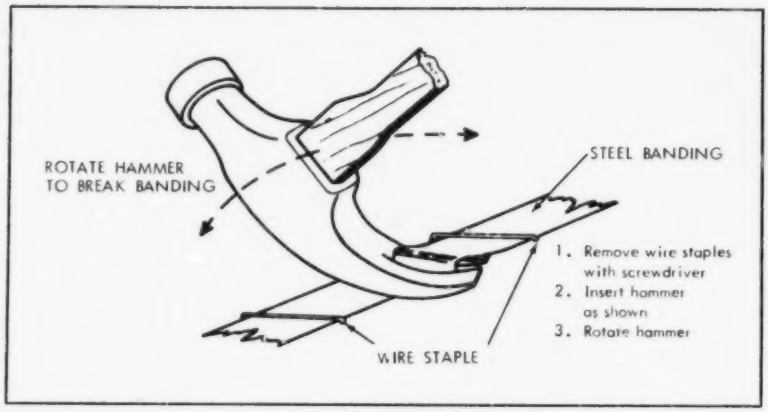
*Occasionally these models may contain a tank by one of the other two manufacturers.




Claw Hammer Used to Break Banding

## 5. Assembly

The individual characteristics of the PDH sites, and prevailing climatic conditions at the time of the disaster, will affect the location and assembly of the PDH water supply equipment. Therefore, some of the following procedures may have to be modified.

***READ ENTIRE INSTRUCTIONS BEFORE STARTING ASSEMBLY***

a. Select the most level area possible within 45 feet of the wall hydrant or *proposed connection to* the water service line of the PDH building. This site should not be more than 15 feet lower than the pumping unit site.

b. Remove from the selected area any sharp or pointed objects that might pierce the tank bottom or ground cloth.

c. Open tank crate near site. Remove components from storage container and spread the 9-foot 3-inch circular ground cloth on the surface where the tank will sit. (Cloth should be free of wrinkles.)

d. Avoid walking or dropping heavy objects on fabric. *CAUTION: Do not drag tank over ground or pavement.* Place the folded tank near the center of the ground cloth and unfold flat, so as many stave pockets as possible are exposed. Center tank on ground cloth with tank fittings toward building. Do not raise tank sides yet.

e. Starting with any bottom stave pocket on the side of the tank, insert each wood stave through the five stave pockets provided for each stave. Rearrangement of tank sides will be required to permit all staves to be easily inserted.

Tanks manufactured by U.S. Rubber Co. have five staves with eye rings and five without. Alternate these staves around tank with *eye rings facing outward and toward tank top* to permit even support of tank walls. Drive a stake about 5 feet from the tank base opposite each of the wood staves having an eye ring. Raise tank walls and tie the longest ropes provided to the eyes of the wooden staves, draw snug, and secure them to the stakes.

f. Attach the stave caps as follows:

***(1) FOR TANKS MANUFACTURED BY ST. CLAIR RUBBER CO. AND FIRESTONE RUBBER CO.***

(a) Select one of the long aluminum caps. Hold with the upper eyelet toward the inside of the tank and slip down over the top of one of the stave and pocket assemblies at the top of the tank wall. Progressing around the top of the tank, skip one stave and then attach a short stave cap with the horizontal eyelet facing the inside. Continue around the top edge of the tank, skipping two staves and on the third stave attach the other long stave cap. Then skip another stave and attach the last or short stave cap.

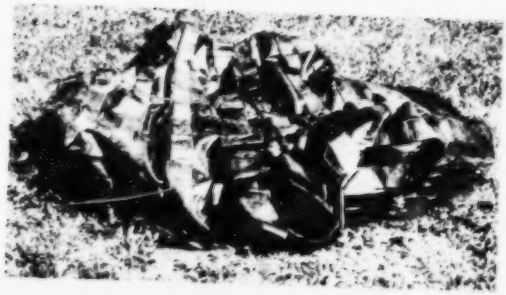
(b) Extend each of the telescoping aluminum support tubes to length approximately equal diameter of the tank. Tighten eyebolts. Ready the assembly pins and cotter pins.

(c) Raise the four staves now having caps and extend the aluminum support tubes across the tank and mate with the caps using the straight pins and cotter pins. Be sure eyebolt of top support tube does not protrude above tube when mated to caps. Expand cotter pins.

(d) Drive one of the four wooden tent pins included approximately 5 feet from the base of the tank opposite each cap assembly. Tie each of the 10-foot guy ropes to the eyes of the cap assemblies, draw snug, and secure to the tent pins.

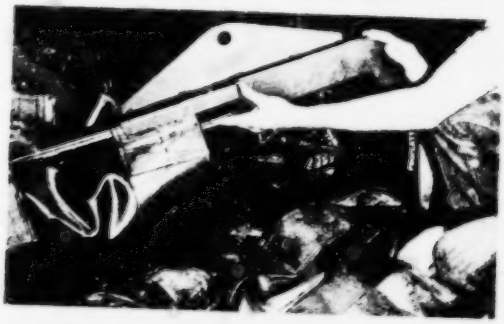
***(2) FOR TANKS MANUFACTURED BY U.S. RUBBER CO.***

(a) Select the aluminum telescoping tube assembly with the smallest stave caps; extend it to the approximate diameter of tank; tighten eyebolts; straddle tank with assembly and position one cap over any stave and the other cap over the stave

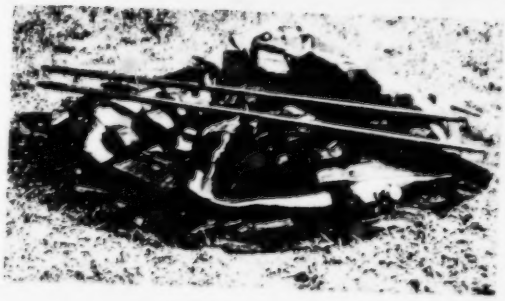


Water tank unfolded flat on ground cloth with stave pockets exposed, refer to the assembly directions, Page 13, section d

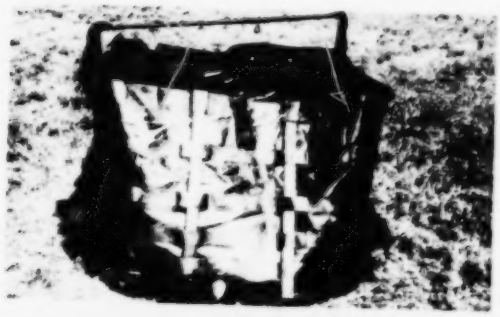
Starting with the bott m stave pocket, stave is inserted through its five pockets, see Page 13, section e



A long aluminum cap is slipped over the top of a stave and pocket assembly, per instructions opposite, section (1) (a).

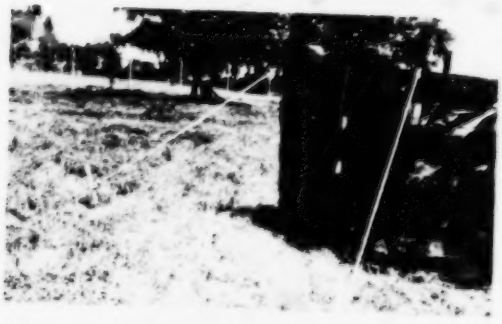


Tank with staves and caps attached and aluminum supports extended to diameter of tank per instructions section (1) (b).

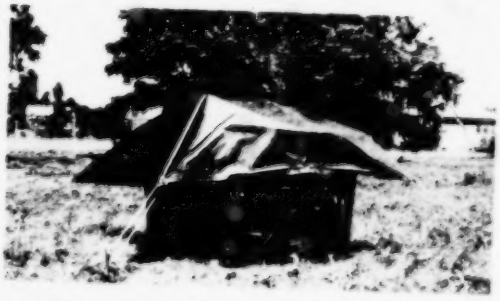


Tank is raised and supports matched with stave caps using straight and cotter pins, see Page 14, section (1) (c).

Four wooden tent pins are driven into ground to secure guy ropes attached to stave caps, see Page 14, section (1) (a).



Guy ropes are secured to lower notch in tent pi leaving upper notch for rope attached to cover, see Page 14, Section (1) (d).



Assembled tank shown with cover secured. After the tank has been disinfected as directed on Page 30, it is ready to fill.

diametrically opposite (i.e. progress around top of tank in either direction skipping four staves and placing the cap on the fifth stave).

(b) Extend the remaining telescoping assembly to length approximately equal to diameter of tank; straddle tank with assembly and position one cap over any stave *not* immediately next to one with a cap as positioned in (a) and the other cap over the stave diametrically opposite, determined as in (a).

g. Unfold the 10½-foot square top cover, and place over tank. Tie shortest ropes provided to corner grommets and secure them to the same stakes used for tying the guy lines.

h. Disinfect tank according to directions on page 30.

i. The tank is now ready for filling and use.

### 6. Repairs to Fabric

Tank need not be dismantled unless it is punctured or torn on the bottom.

a. Each water storage tank is supplied with a fabric repair kit consisting of patching fabric, accelerator and cement compound in cans, sandpaper, cheesecloth, brush, and roller.* The procedure outlined in the following steps will assure a good water-tight patch.

**Note:** ***Personnel entering tank to make repairs should not wear street shoes.***

(1) If tank is punctured, drain, mark location of leak with chalk on the inside of tank, and allow patching area to dry thoroughly.

(2) Cut a patch from the repair fabric 3 inches larger all around than the tank break to be repaired. Round all corners. (Shears not provided in repair kit. Ten-inch trimming shears recommended.)

**Note:** ***When a break occurs at an attachment or seam in the tank, butt patch to seam or attachment—do not overlap. Damage in such areas require two-layer patches. Butt the first patch to the seam or attachment. Put on another patch, overlapping the first and straddling the seam or attachment.***

(3) With sandpaper, roughen an area around the break on the inside of the tank almost an inch larger than the patch to be used. Also buff glossy side of patch. Wipe patch and fabric clean with dry cloth.

**Note:** ***Patch inside and outside of tank if fabric has a jagged tear.***

(4) Prepare cement for application by stirring contents of one cement container and one accelerator container before blending together thoroughly.

---

*PDH Series earlier than 62000 contain fabric, accelerator and cement only.

(5) Brush one heavy coat of mixed cement on roughened areas of tank and patch. Allow to dry 30 minutes. (Cover mixed cement container tightly during drying period to prevent hardening of entire contents.)

(6) Brush second coat of mixed cement over same areas. Allow to dry until tacky. (Test with knuckle after about 15 minutes.)

(7) Position patch over tear and press firmly to tank. Use board backing for support and use roller or equivalent to eliminate air bubbles. Roll from center of patch toward edge.

(8) Brush coat of cement around edge of patch to seal edges and allow to dry thoroughly.

***Note: Special sealer gum material is provided with Firestone Rubber Co. tank, but its use is optional.***

(9) Discard unused mixed cement. Clean brush (for reuse) with unleaded low-test gasoline (not provided). Save empty dry cement containers for mixing cement for subsequent patching.

(10) Disinfect tank interior as directed on page 30. The tank is now ready for use.

## 7. Dismantling Tank

a. Drain the tank and attach dust caps to drain assemblies.

b. Remove the top cover and the tank guy ropes.

c. Dismantle the aluminum support tubes from the stave caps and remove stave caps. Put the aluminum pins with cotter pins in the stave cap eyelets.

d. Remove the 10 wooden staves.

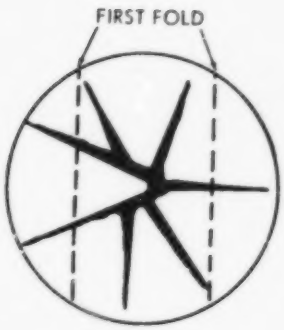
e. Turn the tank completely over to drain any remaining water and then turn back. Be sure tank, cover, and ground cloth are completely dry before folding and repacking.

***F. FOLDING THE TANK: (SEE FIG. 1.)***

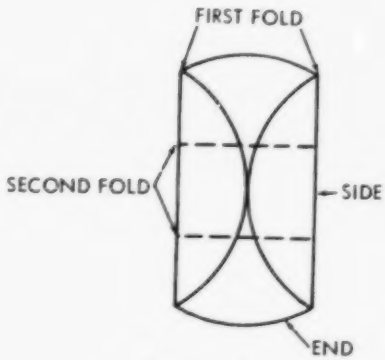
(1) First fold—With the tank in a collapsed position and the upright walls folded in, take opposite sides of the tank and fold both to the center.

(2) Second fold—Fold the rounded ends in, at right angles to first fold, one fold overlapping the other.

(3) Third fold—Fold the sides, in the same manner as noted for the second fold, but at right angles to the second fold.



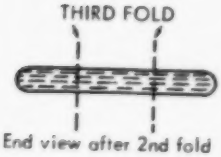

Top view of collapsed tank



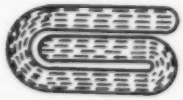

Top view after 1st fold

Side view after 1st fold

Side view after 2nd fold




End view after 2nd fold



End view after 3rd fold

Figure 1.—Folding the Tank

**G. FOLDING TOP COVER:** **(SEE FIG. 2, PAGE 20)**

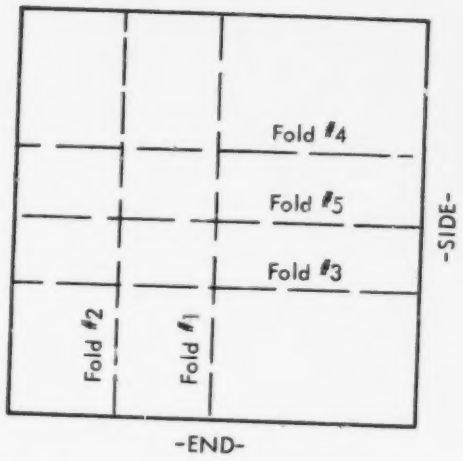
(1) First fold—Fold in half.

(2) Second fold—Fold in half again, same direction as first fold.

(3) Third fold—Fold $\frac{1}{3}$ over, at right angles to second fold.

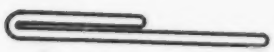
(4) Fourth fold—Fold opposite end over top of third fold.

(5) Fifth fold—Fold in half, bringing fourth fold line over third fold line.



End view after 1st fold

End view after 2nd fold



Side view after 3rd fold

Side view after 4th fold

Side view after 5th fold

Figure 2.—Folding the Tank Cover

h. Place the folded tank cover in the center of the ground cloth and on top of this, the folded tank.

i. Fold two sides of the ground cloth over the ends of the folded tank and top cover.

j. Fold the other two sides of the ground cloth over top of folded tank and top cover.

k. Tie package togeher with two guy ropes (10-foot lengths).

### 8. Preparing for Storage

***Note:** Be sure all parts are dry.*

a. Tie staves together using two of the shortest tie-down ropes.

b. Place bundle of staves at one side of the storage box.

c. Put stave caps, tent pins, ropes, and repair kit items in container provided.

d. Place accessory container at one end of the storage box.

e. Put package of tank, top cover, and ground cloth in the storage box.

f. Lay support tubes (with the eye bolts in place) on top of the tank package.

g. Fasten the lid of the box securely.

## B. PUMPING UNIT

### 1. General

Two manufacturers have supplied pumping units for the PDH's:

| *Manufacturer* | *PDH Series* |
|---|---|
| The New York Air Brake Co., Aurora Pump Division, Aurora, Ill. | 53000, 54000, 55000 |
| Fairbanks, Morse & Co., Kansas City, Kans. | 56000, 57000 62000 |

### 2. Manpower and Connection Time

After being trained, two men can uncrate the pumping unit and make connections in 15 minutes

### 3. Weight

The crated pumping unit weighs approximately 250–280 pounds, depending on model and packing method. A dolly would be useful in moving the crate but is not absolutely necessary.

### 4. Tools

Uncrating tools, including pliers, large screwdriver (12 inch), claw-hammer, and adjustable end wrench should be made available for uncrating PDH's prior to Series 62000.

***Note: Special tools for the pumping unit itself are packed with it (see Water Supply Equipment, p. 8). In the Series 62000 PDH, screwdrivers and diagonal cutting pliers are provided in the PDH tool kit instead of the pumping unit tool box.***

### 5. Connection Procedure

a. Select pumping unit site slightly uphill from water storage tank outlet, if possible.

b. Remove top and sides of wood crate from the bottom wood frame, leaving the pumping unit bolted to the bottom. This provides a stable base for the pump to rest on.

***CAUTION: Do not lift Pumping Unit of Series 53000–57000 by the Pressure Tank.***

c. Position pump so suction side faces outlet of the water storage tank and remove packing materials, if any, from all inlets and outlets.

d. Insert washers in the female swivel assemblies of both hte suction and discharge hoses.

e. Join the two 20-foot lengths of 1¼-inch suction hose using appropriate wrench provided.

#### *(1) Series 62000 Pumping Unit*

(Refer to fitting assembly diagram and schematic, Figs. 3 and 3A, pp. 23 and 24).

(a) Insert washer into the 1¼-inch female socket of the 2-inch hose bushing; attach the bushing to the male threaded end of the 1¼-inch hose and tighten; connect hose (with fittings attached) to the female swivel coupler at the storage tank.

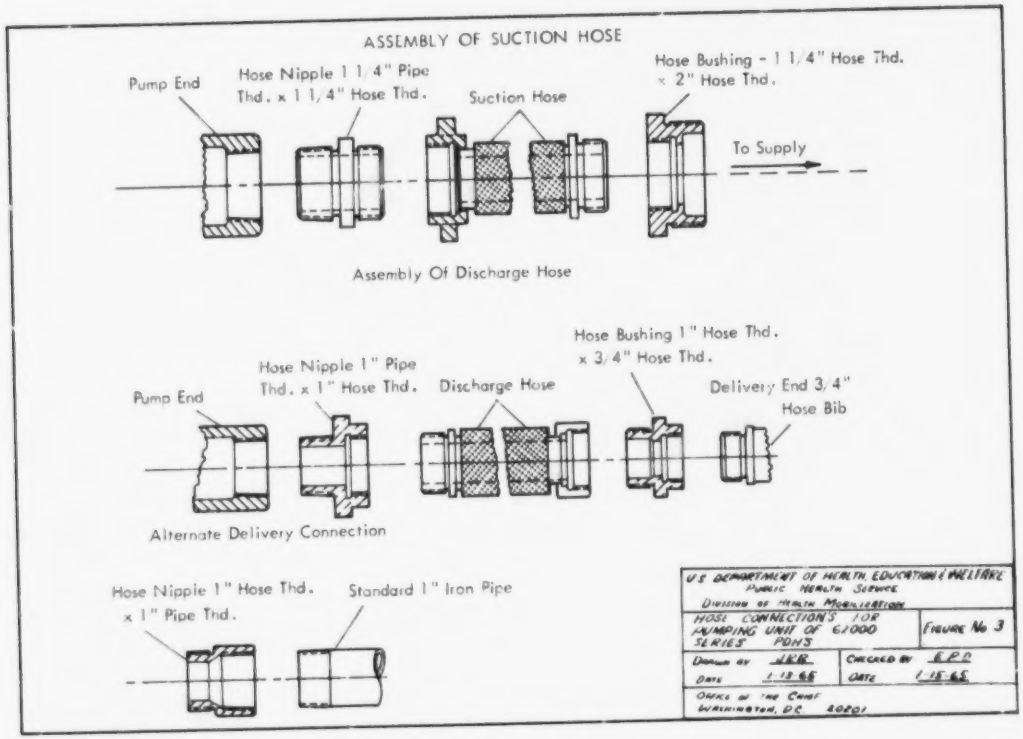

ASSEMBLY OF SUCTION HOSE
Pump End
Hose Nipple 1 1/4" Pipe Thd. x 1 1/4" Hose Thd.
Suction Hose
Hose Bushing - 1 1/4" Hose Thd. x 2" Hose Thd.
To Supply
Assembly Of Discharge Hose
Hose Bushing 1" Hose Thd. x 3/4" Hose Thd.
Hose Nipple 1" Pipe Thd. x 1" Hose Thd.
Discharge Hose
Pump End
Delivery End 3/4" Hose Bib
Alternate Delivery Connection
Hose Nipple 1" Hose Thd. x 1" Pipe Thd.
Standard 1" Iron Pipe
U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
PUBLIC HEALTH SERVICE
DIVISION OF HEALTH MOBILIZATION
HOSE CONNECTIONS FOR PUMPING UNIT OF 6,000 SERIES PDH3
FIGURE No 3
DRAWN BY JKR
DATE 1-13-65
CHECKED BY RPD
DATE 1-15-65
OFFICE OF THE CHIEF
WASHINGTON, D.C. 20201

Figure 3

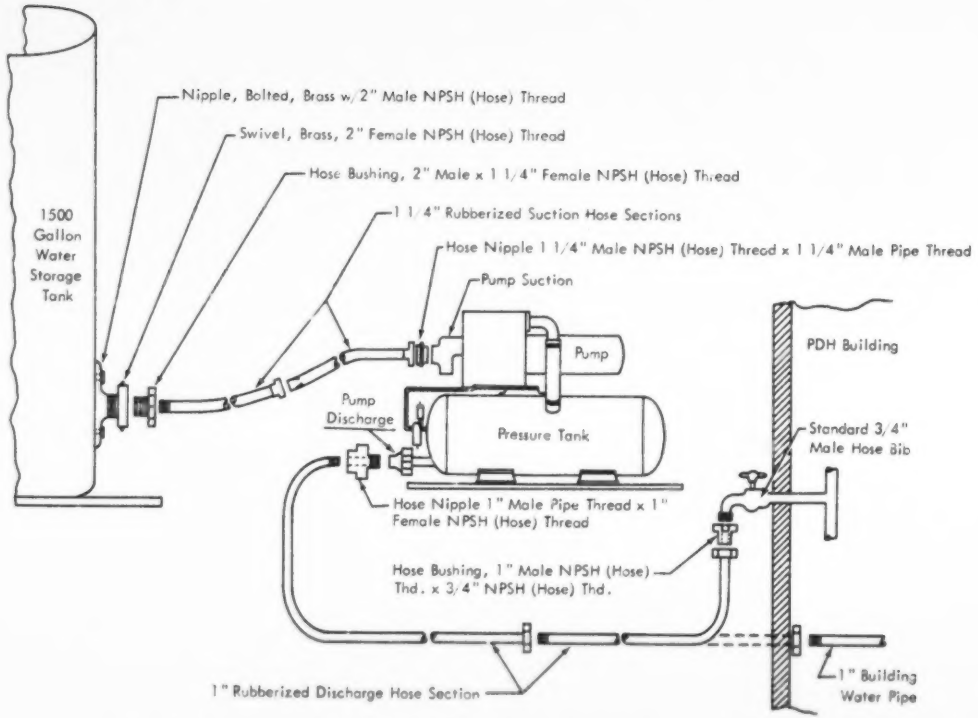

Nipple, Bolted, Brass w/ 2" Male NPSH (Hose) Thread
Swivel, Brass, 2" Female NPSH (Hose) Thread
Hose Bushing, 2" Male x 1 1/4" Female NPSH (Hose) Thread
1 1/4" Rubberized Suction Hose Sections
Hose Nipple 1 1/4" Male NPSH (Hose) Thread x 1 1/4" Male Pipe Thread
Pump Suction
1500 Gallon Water Storage Tank
Pump
Pump Discharge
Pressure Tank
PDH Building
Standard 3/4" Male Hose Bib
Hose Nipple 1" Male Pipe Thread x 1" Female NPSH (Hose) Thread
Hose Bushing, 1" Male NPSH (Hose) Thd. x 3/4" NPSH (Hose) Thd.
1" Rubberized Discharge Hose Section
1" Building Water Pipe

Figure 3A.—Water Pumping Unit Hook-Up (62000 Series PDH)

(b) Apply pipe thread compound to threads of pump suction inlet, and to *pipe threads* of 1¼-inch hose nipple; screw nipple into pump and tighten; connect female swivel coupler of hose to nipple and tighten.

***Note: Pipe thread compounds should be used for fitting which threads into pump only. Washer seals for all hose threads at other joints make use of thread compound unnecessary.***

**(2) Series 57000 and Earlier Pumping Units**

(Refer to fitting assembly diagram and schematic. Figs 1 and 1A, pp. 26 and 27.)

(a) *All fitting and hose connections of these models require the use of pipe thread compound during assembly.*

(b) Assemble the 2" close nipple and the 2" x 1¼" reducing coupling; join to male threaded end of 1¼" hose and tighten fittings; connect hose (with fittings attached) to the female swivel coupler of the storage tank.

(c) Turn 1¼" close nipple into suction side of pump; connect female swivel coupler of hose to it and tighten connection.

f. Join the two 20-foot lengths of 1" discharge hose using appropriate wrench provided.

**(1) Series 62000 Pumping Unit**

(Refer to Fig. 3, p. 23.)

(a) Insert washer into female socket of the 1" brass hose nipple (1" male pipe thread x 1" female hose thread); attach the nipple to the male threaded end of the 1" hose and tighten; apply pipe thread compound to female threads of pump discharge assembly and the pipe thread of the 1" hose nipple; connect hose (with fitting attached) to the female swivel coupler on the pump discharge.

(b) Use whichever of the other two fittings provided with the discharge hose assembly is required to connect the discharge hose to the building piping. If the 1" hose nipple (1" female pipe thread x 1" male hose thread) is required, apply thread compound to both male and female *pipe threads* before screwing it into place. If hose bushing is required, insert washer into female socket before screwing it onto hose bib.

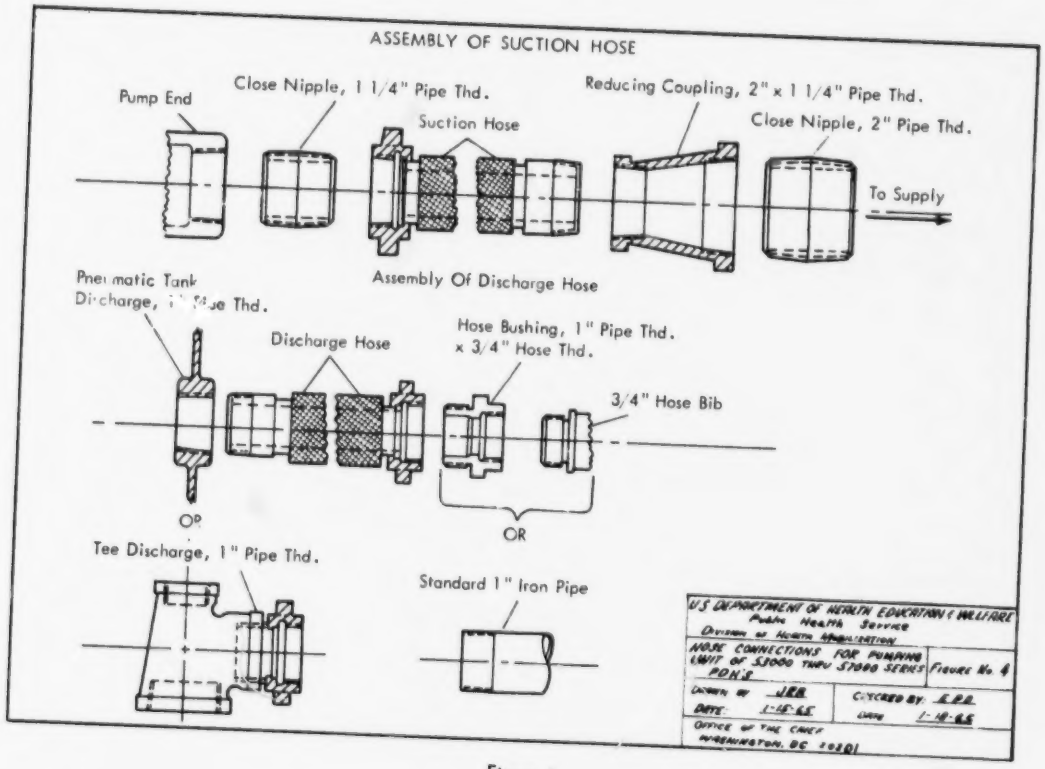

ASSEMBLY OF SUCTION HOSE
Pump End
Close Nipple, 1 1/4" Pipe Thd.
Suction Hose
Reducing Coupling, 2" x 1 1/4" Pipe Thd.
Close Nipple, 2" Pipe Thd.
To Supply
Assembly Of Discharge Hose
Discharge Hose
Hose Bushing, 1" Pipe Thd. x 3/4" Hose Thd.
3/4" Hose Bib
OR
Tee Discharge, 1" Pipe Thd.
Standard 1" Iron Pipe
U.S. DEPARTMENT OF HEALTH EDUCATION & WELFARE
Public Health Service
HOSE CONNECTIONS FOR PUMPING UNIT OF S3000 THRU S7000 SERIES PDH-3
Figure No. 4
DRAWN BY JRB
CHECKED BY R.P.D.
DATE 1-18-65
DATE 1-18-65
OFFICE OF THE CHIEF
WASHINGTON, DC 20201

Figure 4

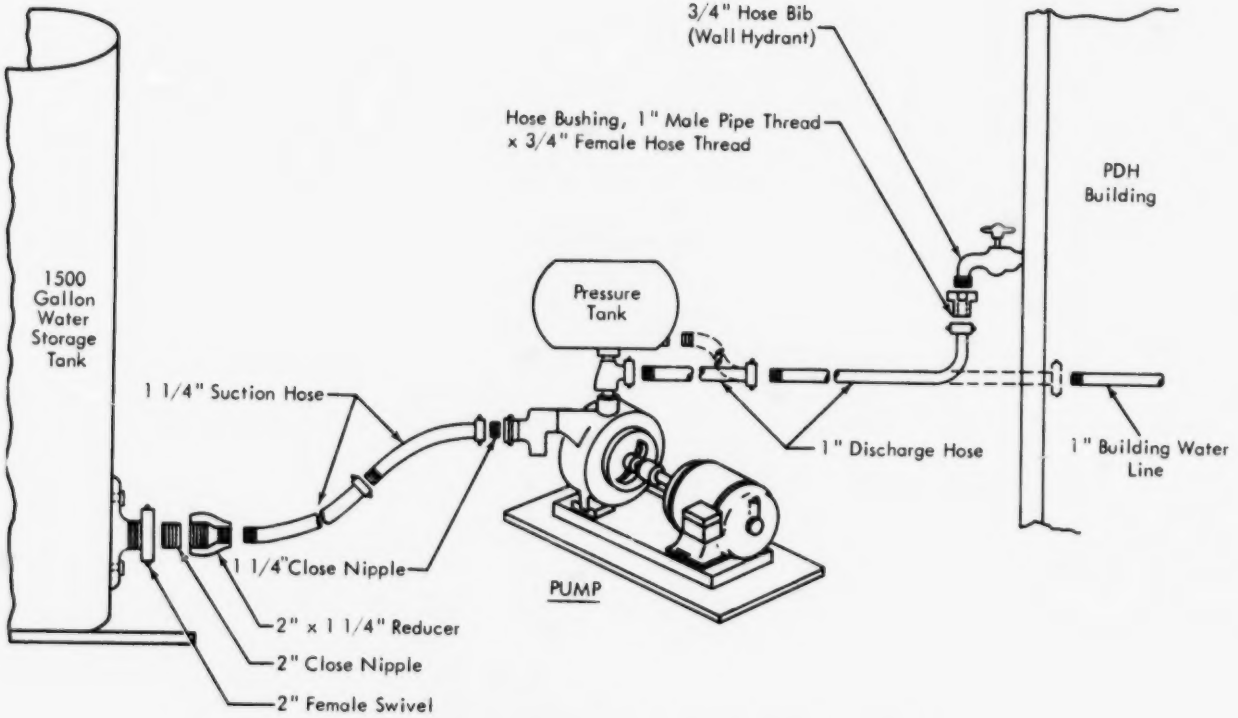



Figure 4A.—Water Pumping Unit Hook-Up (53000–57000 Series PDH's)

(c) Disinfect the pumping unit according to directions on page 30, and then connect the discharge hose to building piping.

#### (2) Series 57000 and Earlier Pumping Units

(Refer to Fig. 4, p. 26.)

(a) Select proper fitting to adapt 1" hose to building and attach to building pipe or hose bib accordingly using thread compound on *pipe* threads before screwing fitting into place.

(b) Connect discharge hose to pneumatic tank or tee discharge of pump. Use thread compound and disinfect pumping unit according to directions on page 30. Following disinfection, make the water delivery connection to the PDH building.

## 6. Operation

The pump is intended to supply water under pressure to a building piping system or to temporary waterlines run to essential areas of the PDH. The unit does have other applications, but they require competent technical supervision and additional supplies. The details of pump operation given here describe only the primary use of the pump and accessories.

### a. Priming the Pump

One of three methods of pump priming must be utilized depending on the model of pump at hand.

#### (1) AURORA PUMP WITH CHECK VALVE AND GATE VALVE BETWEEN PUMP AND PNEUMATIC TANK

(a) Remove plug or cover plate from pump priming device and pour potable water into opening until water stands at the level of the pump intake opening.

(b) Wait a few minutes for any entrapped air to bubble out. Replace plug or cover plate and tighten.

(c) Add disinfecting solution to water storage tank (p. 30). After disinfecting, maintain chlorinated water level in storage tank sufficient to prevent pump from running dry.

#### (2) AURORA PUMP WITH TEE DISCHARGE BETWEEN PUMP AND PNEUMATIC TANK

(a) Remove $\frac{1}{4}$" plug from pressure tank and pour about 1 gallon of potable water into tank.

(b) Replace plug and follow disinfecting procedures as in (1) (c) page 28.

#### (3) FAIRBANKS, MORSE PUMP

(a) Remove priming plug from atop pump and fill pump with potable water.

(b) Replace plug after several minutes lapse to allow entrapped air to escape.

(c) Follow disinfecting procedures as in (1) (c) page 28.

### b. Starting the Pump

(1) Plug electric cord into a 115–120-volt fused circuit receptacle of electric power distribution system or generator.

(2) Turn hand-operated switch on side of pressure switch to ON to start pump. If pressure does not begin to build up in pressure tank or water does not discharge from pump within 5 minutes, turn disconnect switch to OFF and reprime as above. (If fuse blows, check voltage being supplied to pump motor and make appropriate adjustments or determine other causes before replacing fuse.)

### c. Characteristics of Normal Operation

(1) The pump will stop when the pressure tank pressure reaches 40 psi and will restart when the pressure falls to 20 psi.

(2) No pressure adjustments will normally be required but in the event they are desirable, RANGE and DIFFERENTIAL adjustment screws are provided in the pressure switch housing. Remove cover on pressure switch housing and turn screws in appropriate direction.

(3) Lubrication of the Fairbanks, Morse pumping unit is not required except for a few drops in sleeve bearing oiler before starting initial pump operation. Earlier model pumps have grease cups to which ball bearing grease has been added at the factory. Before starting initial pump operation, screw caps down several turns; repeat this every 6 months of operation thereafter. Replenish with grease when caps no longer turn.

(4) Operation of the pumping unit is most efficient when hose connections and fitting joints are tight so that leaks are prevented. Dry joints also show that water is not being lost.

# DISINFECTION PROCEDURES

## A. DISINFECTING WATER STORAGE TANK AND PUMPING UNIT

Before being placed in service, the entire emergency water supply section of the PDH must be disinfected to remove any contamination that might have been introduced during assembly. The procedure is as follows:

**1.** After assembling the tank and pumping unit components, but before connecting them to the building water supply system, pour into the storage tank a *slurry* made of 2 tablespoons and 1 teaspoon (7 teaspoons) of 70 percent calcium hypochlorite (such as *Perchloron* or *HTH*), and 1 gallon of water. Add enough water from the potable supply to cover the tank floor with about 4 inches of water. This will result in a solution containing a chlorine concentration of about 50 ppm. If *Perchloron* or *HTH* is not available, 2 cups of ordinary household bleach (5.25 percent sodium hypochlorite) may be used in place of the *slurry*. Add one-half pint of vinegar, if available, to the solution in the tank.

**2.** Start the water pump and discharge the solution back into the storage tank. (See p. 28 for pumping unit operation.) Allow the solution to recirculate for 20 minutes.

**3.** While recirculating the solution, scrub thoroughly on all interior surfaces of the storage tank (including the underside of the tank cover) with a clean broom or a longhandled window brush. Following the scrubbing, direct the discharge from the water pump onto all interior surfaces of the tank and cover for the final 5 minutes of the recirculation phase.

**4.** If the liquid discharging from the pump carries a very strong odor of chlorine following the recirculation phase, the tank may be emptied and the entire unit flushed as specified in Section B.2. following. The tank would be emptied by discharging to waste or to storage barrels for manual flushing of sanitary fixtures. If a strong odor of chlorine is not present, a new slurry or its equivalent must be added to the tank and the entire procedure repeated.

## B. DISINFECTING PIPING SYSTEM

Before pumping into a building piping system, the main water supply valve from the outside service line into the building must be shut off, so that the emergency water supply is not pumped back into the public water mains and lost.

If it is suspected that the building piping system has been contaminated, or if the system is not under pressure, it should be disinfected before using. This can be done as follows:

**1.** Instead of discharging the chlorine solution in the storage tank to waste, as explained in A.4., p. 30, connect the discharge hose of the pumping unit to the building piping system. Open all outlets on the water line and pump the solution through until the water discharging from the faucets carries a strong odor of chlorine. If the PDH building piping system is extensive, additional batches of chlorine solution will be required. (See A.1., p. 30.) Close the faucets and allow the solution to remain in the line under pressure for 20 minutes. Now open the faucets. If a strong odor of chlorine is still present, the remaining solution in the storage tank, if any, can be discharged to waste, either through the building pipeline system or to the ground surface through the pumping unit discharge hose after disconnecting it from the building piping system. If a strong chlorine odor is not present upon opening the faucets, this procedure must be repeated.

**2.** After emptying the solution from the tank, the entire unit (storage tank, pumping unit, connecting hoses, and building piping, if disinfected) must be thoroughly flushed, using the potable water supply. Flushing should continue until the water discharging from the pumping unit, or building faucets, carries only a very slight chlorine odor, or until the desired chlorine residual is reached.

**3.** The water supply section of the PDH is now ready to place in service. Connect pump discharge hose to the wall hydrant or supply line if not already done, add chlorine solution to the tank according to C.1. following, and fill the storage tank from the potable water supply. Then secure the tank cover.

## C. CHLORINATION OF TANK WATER SUPPLY

Assuming existing water mains to the PDH building are damaged by the disaster, transportation equipment will be required to deliver water from any of the alternate water sources, suggested on page 4 to the site of the PDH. All water transported by vehicle will first be received in the PDH water storage tank provided for bactericidal treatment.

Each time the 1,500-gallon water tank is filled with water for use in the PDH, chlorine in one form or another is to be added as a safety precaution, regardless of the source of the water. To chlorinate the water:

**1.** Mix 2 teaspoons of 70 percent calcium hypochlorite powder (or two tablets of 70 percent hypochlorite or $\frac{1}{2}$ cup of 5.25 percent liquid household bleach) in about 1 gallon of water. The gallon of chlorine solution should be poured into the tank prior to filling so that it will be thoroughly mixed with the 1,500 gallons of water by the time the filling process is completed. This procedure provides approximately 1 ppm (part per million by weight) of chlorine. If the chlorine solution is not added prior to filling the tank, a clean paddle (not provided) should be used to thoroughly mix the solution into the water.

**2.** Allow water to stand for 5 minutes. Take a sample of water from the tank and measure the chlorine residual, using the chlorine comparator in the kit provided. If the chlorine residual is greater than 0.5 ppm, the dosage of chlorine is satisfactory.

**3.** If the chlorine residual is less than 0.5 ppm add to the tank another gallon of water containing 2 teaspoons of hypochlorite (or 2 tablets of hypochlorite or $\frac{1}{2}$ cup of liquid bleach), stir well, let stand for 5 minutes, and again measure the chlorine residual with the chlorine comparator. Repeat this procedure until the chlorine residual is greater than 0.5 ppm.

Unless the water being furnished to the PDH can be pumped directly to the building through disinfected emergency lines, the PDH water storage tank should not be bypassed. Approval of bypass action should be obtained from the health officials in charge before making such hookups.

# USE OF CHLORINE RESIDUAL COMPARATORS

## A. GENERAL PRECAUTIONS

**1.** Before sampling, be sure that all equipment and glassware is clean.

**2.** Be sure to keep samples out of the sunlight during the 5 or 10 minutes in which maximum color is developing for the test. Sunlight fades the color quickly.

**3.** Read the instructions for chlorination and chlorine residual test carefully and be sure you understand them before attempting to test and evaluate the water supply.

## B. CHLORINE COMPARATOR KIT IN SERIES 62000 PDH

This kit is in a hardwood case 5½ inches long, 4⅝ inches wide and 4 inches high. The kit has the following components:

1. A black plastic comparator with four permanent glass color standards, showing 0.1, 0.3, 0.5, and 1.0 part per million of residual chlorine as determined by the orthotolidine indicator. Color standards are located on the front of the comparator near the sides. Two center openings of daylight glass are provided for viewing samples. An opal glass is mounted on the back of the comparator to diffuse light through the samples.

2. Five 13-millimeter (mm) square glass tubes of clear colorless glass with ground water or etched line at 10 milliliter point.

3. One hundred and fifty orthotolidine dihydrochloride tablets, 0.6 mg. (0.01 gr.) in glass bottle and one plastic stirring rod.

4. Complete instructions for use in testing for chlorine are posted securely on the inner surface of the cover of the case. These instructions are as follows:

a. Clean three sample tubes and fill two of the cleaned tubes to the etched mark with water to be tested: place these tubes in the two outer compartments of the comparator.

b. To the third tube, add a few drops of the water to be tested and one orthotolidine tablet. Crush the tablet with the stirring rod, then fill the sample tube to the etched mark with water to be tested and mix thoroughly by placing clean dry portion of the hand over top of tube and inverting a few times. Place this tube in the center compartment of the comparator. *Set comparator out of the sunlight* and allow 5 to 10 minutes for maximum color to develop. Compare developed color in center tube with glass color standards and then estimate chlorine content of water to nearest 0.1 ppm.

## C. CHLORINE COMPARATOR AND pH TEST KIT IN SUPPLY ADDITION NO. 2

This kit contains the following parts:

1. Test tube, with stopper
2. Vial of 40 orthotolidine tablets
3. Six color chips with chlorine readings of 0.3, 0.7, 1.0, 3.0, 5.0, and 10.0 ppm chlorine.
4. Plastic bottle of wide range pH solution.
5. Five pH standard chips with readings 5.0, 6.0, 6.8, 7.4, and 8.0.
6. Instruction card.
7. Plastic box.
8. Two hundred and sixty ortholidine tablets and sufficient pH solution packaged in separate container, but packed in the same box, to provide for a total of 300 tests.

Instructions for using this kit for chlorine residual tests are as follows:

1. Crush one orthotolidine tablet in a square of clean paper and pour into clean test tube. Add a few drops of the water to be tested and let stand until the grains of the crushed tablet are broken down. This may take several minutes depending on age of the orthotolidine tablets. (The older the tablet, the longer the time required.)

**2.** Fill the test tube to the 10 ml. marks with water to be tested. Place the cork in the tube and invert several times to mix the contents. Place the test tube out of the sunlight and allow color to develop for 5 to 10 minutes.

**3.** Compare color formed with the color chips. If color is a shade between two chips, estimate chlorine residual to nearest tenth or to nearest ppm.

The general procedures for making pH determination is the same as for chlorine residual determinations except that a pH reagent must be used instead of the orthotolidine tablets. The color change is practically instantaneous and may be read at once.

The reagents used in making pH determinations are susceptible to change through bacterial action if the solution becomes contaminated. Care must be taken, therefore, not to contaminate the supply of indicator solution by getting the dropper into the sample of water being tested.



U.S. GOVERNMENT PRINTING OFFICE : 1965 O—775-002

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Public Health Service
Publication No. 1071–F–6